Drip Irrigation

• Has a long history in Agricultural Applications
• Often promoted as an “Efficient” alternative to sprinkler or flood irrigation methods
• In Truth....
  • “Only as efficient as the person behind the design, installation and management of the system”
Drip Components
Operation and Maintenance
Components of Drip Systems

• Manual or Remote Control Valve
• Drip Products
• Flow Meter
• Pressure Gauges
• Pressure Regulators
• Backflow Prevention Devices
• Screens & Filters
• Flushing Valves
• Injection Equipment
Drip Products

- Drip Products used in Vineyards
  - Drip Tubing
  - Point Source Emitters
Drip Tubing

• Poly Tubing with drip emitters inside the tubing
• Emitter Spacing is set in the manufacturing
  • Common spacing's: 6”, 12”, 18” & 24”
• Limited Emitter Flow Rates
  • Flow Rates Vary from .26 GPH to 1 GPH
• Most often used for buried applications
Point Source-Insert Emitters

- Emitters are inserted into a poly tubing at user designed spacing's
- Emitter flow rate can vary from .5 GPH to 24 GPH
- Some emitters are pressure compensating
- Often not rated for direct burial
Drip Specification - Performance

NonStop Drip Emitters
Nominal Performance

Flow, GPH (LPH) vs. Pressure, PSI (bars)

- 2.0 GPH Models*
- 1.0 GPH Models*
- 0.6 GPH Models*

Notes
- 30-mesh filtration and 15 PSI emitter operating pressure are the recommended minimums for a NonStop emitter system.
- Manufacturer's variation, $C_V \leq 0.05$

*Nominal Flow at 20 PSI
Flow Meters

- Flow meters help growers monitor water usage
- System flow rates will vary based on design and number/size of emitters
- Knowing flowrates helps: scheduling, maintenance, chemigation, etc.
Pressure Gauges

- Every Irrigation System/Station has a design pressure
- Monitoring pressure helps identify if/when maintenance maybe be needed
- Pressures > Design
  - Clogging Concern?
- Pressure < Design
  - Leak Concerns?
Backflow Prevention Assembly Devices

• Safety device which prevents the flow of water from the irrigation system back to the water source
• Typically required on systems that use potable water, groundwater or chemigation
• 4 Main Types of Backflow Devices
  • Atmospheric Vacuum Breaker – AVB
  • Double Check Assembly – DC
  • Pressure Vacuum Breaker – PVB
  • Reduced Pressure Principle Assembly - RPZ
Backflow Devices

- AVB
- PVB
- DC
- RPZ
Pressure Regulators

• Drip products vary in their pressure requirements
  • 10 PSI to 50 PSI+
• Some systems require pressure regulators to achieve manufacturers recommended pressure requirement
• Some devices have pressure regulators built in
• Often installed after the station valve
Screens & Filters

- Used to catch plastic and sediment in the irrigation water
- Prevent clogging of emitters and valves.
- Should be checked at least seasonally for concerns
Screens & Filters

• Screen filters are used for drip systems connected to municipal water sources and other “clean” water sources such as groundwater

• Sand media filters or disc filters may be required for drip systems connected to surface water (rivers, lakes, ponds, etc.)
Filters

- Drip irrigation systems MUST include a filter
- With groundwater, a screen (mesh) filter is normally satisfactory
- Choose the mesh size of the filter using manufacturer’s recommendation for the exact product being used

**OPERATING SPECIFICATIONS**
- Recommended pressure range: 20 to 50 PSI
- Minimum filtration 150 mesh; 100 microns

**OPERATING RANGE**
- Pressure: 8.5 to 60 psi (58 to 414 bar)
- Flow rates: 0.6 and 0.9 gph (2.3 l/hr and 3.5 l/hr)
- Temperature:
  - Water: Up to 100°F (37.8°C)
  - Ambient: Up to 125°F (51.7°C)
- Required Filtration: 120 mesh
Flushing Valves

• When sediment becomes trapped in the drip product, a flushing valve is used to remove it.
• Flushing valves can be automatic or manual.
Chemigation Injectors and Pumps

The most common types:

• Mechanical
  • Piston (positive displacement) pumps
  • Diaphragm pumps

• Venturi meters
Piston/Positive Displacement Pumps

• Uses a “piston” to inject chemical into the irrigation water

• Rate is determined by the
  • length of the stroke
  • number of strokes per minutes

• Chemicals come into contact with piston, so materials should be matched to prevent corrosion
Piston/Positive Displacement Pumps

Injection rate remains constant and does not change if the irrigation pipeline pressure varies

- Injection rates cannot be adjusted while operating
- Commonly used to inject fertilizer (large rate injection)
Piston/Positive Displacement Pumps
Diaphragm Pumps

- A membrane separates chemical from the drive mechanism (piston)
- Easy to adjust flow rate while operating
- Commonly used for low-rate injection (pesticides, etc.) or continuous injections (chlorine or acid to lower pH)
- Easy to calibrate and maintain
Diaphragm Pump
Venturi Meters

• Simple device with no moving parts
• The meter used a reduced diameter throat tube (or a tube with a needle valve or orifice plate)
• Velocity changes in tube create vacuum to pull chemical into stream
• Venturi Meters are sized based on system flow rate, pressure and desired injection rate
Venturi Meters

• Most low-end venturi injectors are not adjustable and have a constant proportion injection rate such as 1:50
  (one gallon injected for every 50 gallons flowing through meter)
Venturi Meters
Chemigation Practices
Chemigation

*General term that includes:*

- Fertigation
- Insectigation
- Fungigation
- Nematigation
Advantages of Chemigation

• Uniformity of application
• Precise application
• Economics
• Timeliness
• Reduced soil compaction and crop damage
• Operator safety
Disadvantages of Chemigation

- High management
- Additional equipment
- Must calculate injection rates and volumes
Chemigation and Regulations

• General Classes
  • Controlled Substances
    • Pesticides and Herbicides
  • Fertilizers and Nutrients
  • Drip Maintenance/Clogging Control Chemicals
    • Chlorine and Acids
Controlled Substances

• Pesticides and Herbicides
  • Highly regulated by the EPA and States (TCEQ)
  • Regulations cover labeling, mixing/injection, and equipment
  • Regulations designed to protect the environment, human health and water supplies
• State Licensing Requirements
Fertilizers

- Frequently injected into drip irrigation systems
- Dry and Liquid formulations are available
- Liquid formulations are more expensive but are very convenient
  - Can be injected directly (without mixing with water) with a variable rate injector.
Fertilizers

• Fertilizers containing phosphorus and sulfur may react with calcium and/or magnesium in irrigation water
  • Forming precipitates that could clog emitters
• Micronutrients can also cause precipitates
• Consult with supplier before use or test prior to injection
The US EPA’s Label Improvement Program (LIP)

• Established in the 1980’s
  • Fully implemented in 1988

• States were required to implement regulations at least as stringent as proposed by the EPA

• Labels must state whether product is approved to be applied through the irrigation system

• Application instructions are provided

• Requires use of specific safety equipment and devices designed to prevent accidental spills
CHEMICAL INJECTION SAFETY CONNECTIONS

- Irrigation pipe line
- Automatic low pressure cutoff
- Electric motor and pump
- Electrically interlocked control panels
- Vacuum relief valve
- Check valve
- Injection and automatic check valve
- Injection unit
- Agitator
- Electric connection
- Chemical discharge line
- Normally closed solenoid valve electrically interlocked with injection pump
- Injection pump and electric motor
- Injection hose
Clogging Control

Chemigation
Types of Clogging

- Biological
  - Aglae
  - Bacteria
- Mineral
  - Iron
  - Calcium/Lime
  - Salts
  - Etc.
Chlorine

• Injected to control biological clogging of lines and emitters

• Household bleach is often used in small systems (5.25% chlorine)

• 5 ppm solutions commonly used

• Higher concentrations (up to 100 ppm) if iron bacteria and/or organic matter are problems
Chlorine

- Chlorine concentration at the end of the drip line should be:
  - 1 to 2 ppm for occasional treatment
  - 0.5 to 1 ppm for continuous treatment
- Begin with a low concentration (5 ppm to 10 ppm) for one hour
Useful Conversion Factors

1 ppm = 1 mg/l
1 ppm = 1 mg/kg
1 % = 10,000 ppm
1 % = 1.33 oz (by weight) per gal of water
0.1% = 1000 ppm
Acid Injection

• Acid is injected to control mineral clogging of emitters

• Water with a high pH (>7.5) or “moderate” to “hard water” (>60 ppm Ca) more likely to cause problems
Acid Injection

• 98% sulfuric acid is commonly used in drip irrigation
• Citric acid or vinegar can be used in organic farming
• Titration can be used to determine concentration of acid need

(adding acid to a sample of the water to see how much is required to lower pH)
Acid Injection

• Laboratories can do a titration analysis which will determine the amount of acid needed to lower the water to a certain pH

• the injection rate (gal per hour) of acid is calculated by

\[
IR = \frac{(A \times Q \times 60)}{326,000}
\]

IR= injection rate, gal per hr
A = gal of acid needed to lower pH (per ac-ft)
Q = Flow rate of irrigation system (gpm)
Acid Injection

• Experimentation is used in absence of titration
• Acid is injected until pH is lowered to 6.5 (measured at end of drip line)
• Higher concentrations are added if needed, lowering pH to as low as ~4
• Acid is corrosive – inject downstream of filter if made of metal
  • Pay attention to any metal components in the irrigation system
Water Quality

• Highly Recommended water sources be tested prior to any chemigation to avoid negative reactions
• TAMU Soil Testing Lab has specific analysis for water used in drip irrigation
  • More info at http://SoilTesting.tamu.edu

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<tbody>
<tr>
<td>1. Routine Analysis (R)</td>
<td>$25 per sample</td>
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<tr>
<td>(Conductivity, pH, Na, Ca, Mg, K, CO$_3^{2-}$, HCO$_3^-$, SO$_4^{2-}$, Cl$^-$, P, B, Nitrate-N, Hardness, and SAR)</td>
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<tr>
<td>2. R + Metals</td>
<td>$40 per sample</td>
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<tr>
<td>In addition to Routine Analysis includes: (Zn, Fe, Cu, and Mn)</td>
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<tr>
<td>3. R + Titrate of Drip Irrigation</td>
<td>$33 per sample</td>
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<tr>
<td>4. R + Metals + Titrate for Drip Irrigation</td>
<td>$47 per sample</td>
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<tr>
<td>5. R + Metals + Heavy metals and Fluoride</td>
<td>$75 per sample</td>
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<tr>
<td>In addition to test number 2, includes As, Ba, Cr, Cd, F, Ni, Pb.</td>
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<tr>
<td>Hardcopy mailed to address listed above</td>
<td>$2 per invoice</td>
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Questions?

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